Developmental Connections between Verb Inflection and Subject-Verb Inversion in Pre-school Children with Specific Language Impairment

A Senior Honors Thesis

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by

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Abstract

This study investigates children's receptive ability to distinguish finite from nonfinite verbs as well as inverted from uninverted questions. Child English speakers produce both types of non-adult constructions. Specifically, child English speakers with SLI are known to have problems with verb finiteness marking and question formation, but the two have not yet been tested together to determine whether there is a contingency between them. Our research aims to determine whether a theoretical connection posited between the two adult-like constructions is visible in the development of child English and whether a difference in comprehension of these grammatical constructs exists between children with specific language impairment (SLI) and their typically developing peers. Two tests were administered to each child in this study, the Nonfinite Verb Grammaticality Choice Task and the Subject-Auxiliary Inversion Grammaticality Choice Task (Pratt and Grinstead 2007). Each question on the tests consisted of two statements: the adult like form and the child-particular form. Children were asked to choose the statement which they thought was correct. One hundred six typically developing children between the ages of 3;1 and 5;11 participated in this study. The mean age of the 63 children who passed both tasks was 4;10.

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Chapter 1: Introduction and Literature Review

Many theories have been generated concerning the acquisition of certain grammatical structures in child English. Two major topics in language acquisition are the comprehension and production of verb finiteness and subject-verb inversion. Children who have not yet fully developed their grammatical abilities, typically between the ages of 3 and 5, will interchangeably produce verbs with marked finiteness as well as verbs with nonfinite forms:

(1) The boy <u>eats</u> ice cream.

(2) The boy <u>eat</u> ice cream.

Children around this age also produce questions in which the subject and verb have been inverted properly, as well as uninverted questions:

(1) What <u>does</u> mommy do?

(2) What mommy <u>does</u> do?

The underlying question remains, are the two grammatical constructs related? There are two main theories that exist in today's research which hold opposing answers to this question. Constructivist theory (e.g. Freudenthal, Pine & Gobet 2009) assumes that there is no relationship between verb finiteness and subject-verb inversion whereas Generativist theory (e.g. Rizzi 1996, Den Besten 1983) hypothesizes that there is indeed a connection between the two linguistic concepts. This research investigates the question in an expanded version of an earlier project (Warren 2007) and asks the same question in a different population: children with SLI.

While the grammatical development of finiteness and inversion in typically developing children has been researched extensively, there has been an additional focus put on the comparison of specific language impaired (SLI) children to their typically developing peers. Much research has been done on the linguistic capabilities and inabilities of the SLI population. This project has clinical implications. Through the discovery of a linguistic connection between verb finiteness and subject-verb inversion, we are one step closer in piecing together the puzzle of the grammatical deficits that exist in children with specific language impairment, with the goal of classifying the disorder with more well-defined characteristics than the current exclusionary attributes. With this increased knowledge of SLI, we have hope of gaining more knowledge on how to diagnose and treat this disorder at the earliest developmental stage possible.

Finiteness: V-to-I Movement and Subject-Aux Inversion: I-to-C Movement

Finiteness marking on verbs has been argued to be the result of verb movement, as the work of Emonds (1970) and Pollock (1989) shows. The idea is that verbs move from the head of the Verb Phrase (VP) to the head of the Inflectional Phrase (IP) position (Chomsky 1989). From the head of IP, verbs then will move to the head of the Complementizer Phrase (CP), a structurally higher syntactic position, as defended by den Besten (1983) and Rizzi (1996). This entire syntactic movement of a verb is know as V-t-I-to-C and presents itself as a subject-auxiliary inversion. According to the Head Movement Constraint of Chomsky (1981) and Travis (1984) verbs that move to C in the production of a question *must* first move to I. Verbs may not skip I and traverse directly

from V-to-C. In other words, a nonfinite verb cannot be presented before the subject position, as illustrated by Figure 1.

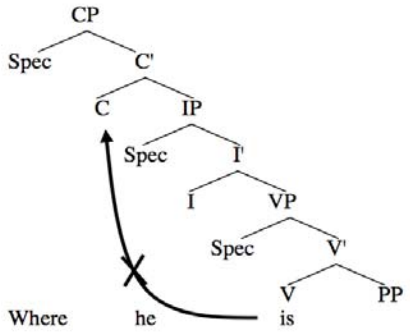

Figure 1 – Nonfinite verbs do not move above subjects in *wh*- questions

Syntactic Theory in Children Regarding Subject-Verb Inversion

In order to better understand the basis for child language acquisition, it is important to establish what is known about the syntactic structures of adult grammar with respect to inversion. Some research has argued that the adult syntactic structure of subject-auxiliary inversion is based purely on a set of patterns that deviates from the typical sentence structure (Goldberg 2005) whereas others believe that there is a definite connection between the presence of finiteness marking and inversion (Rizzi 1996).

Subject-auxiliary inversion is a construction in which subjects occur to the right of finite verbs. It occurs in yes-no questions, *wh*- questions, quotative inversion, among others. For example, as given in Goldberg (2005), inversion can be seen in the yes/no interrogative *Did she go?* as well as in *wh*-interrogative such as *Where did she go?* It has been the subject of much debate in child language literature because children do not use it in an adult-like way during an early period of their development. As Rowland and Pine (2000) explain, children produce the non-adult like forms (e.g. *what you can*

do?) around the same time period in which they also produce the correct adult-like form (e.g. *what can you do?*). Constructivist theory states that when children make subject-auxiliary inversion errors, it is not due to a lack of syntactic knowledge, because there is no syntax involved in the production of *wh*-questions. They claim that children memorize patterns heard more frequently in their language input, which involve different combinations of *wh*-question words and auxiliaries (Rowland & Pine 2000). Crucially for our analysis, constructivists do not assume that there should be any connection between children's abilities to mark finiteness (tense and agreement) on verbs and their abilities to invert subjects and objects.

On the other hand, Generativist approaches to the problem have proposed solutions framed in terms of syntactic theory. Valian, Lasser & Mandelbaum (1992), for example, suggest that the reason children produce errors in inversion is because they use an "optional inversion" rule when producing questions. By attending to this rule, they may likely use both a correctly structured inverted form as well as an uninverted form because both types are allowed by the optional inversion rule. The adjunct analysis theory (deVilliers 1991) claims that the reason why children make non-inversion errors is because they treat all *wh*- words as if there were "Why" questions such as "Why clean up my room?" or "Why black tape?" which seem to attach or adjoin to any category. DeVilliers suggests that children treat adjunct and argument *wh*-words differently, and that the adjunct words will occur for a longer period of time in an uninverted state than the argument words. In most all of the generative approaches to this problem, it is assumed that verbs move in subject-auxiliary inversion constructions, just as they do in declarative sentences in order to be inflected as finite.

Finiteness in Typically Developing Children - The Optional Infinitive Stage

If generativists are correct that finiteness and subject-auxiliary inversion are related in the adult grammar and that finiteness marking is a necessary condition for subject-auxiliary inversion, then we must investigate the nature of finiteness marking in child language. Wexler (1994) proposes that errors in finiteness marking in children occur due to the fact that the children are acting in an Optional Infinitive (OI) stage of grammatical development. In this Optional Infinitive stage, which occurs between the ages of 3 and 5, the use of finiteness marking on verbs and the use of the bare stem of the verb are produced interchangeably. As far as the child is concerned, grammatically speaking, both forms are correct. While this production appears to deviate from adult grammatical constructs, it is accepted as a natural step in the child's grammatical development.

V-to-I-to-C in Typically Developing Children

In studying the development of yes/no questions and the inversion that takes place in these question types, Santlemann, Berk, Austin, Somashekar & Lust (2002) propose that when errors occur in the production of questions, the problem is a result of the underlying V→I→C movement that must occur in order for the sentence structure to appear as a question. Santlemann explains that when I→C movement (inversion) is the only distinguishing factor between the question and the declarative formation (as in the sentences *Kermit is eating a cookie. Vs. Is Kermit eating a cookie?*), there will not be a significant delay in the production of inverted word order. The more challenging developmental change for children lies in the sentences where verbs require the V→I

movement as well. It is assumed, under Santelmann's theory, that lexical and copular *be* verbs will prove more challenging, hence, producing more uninversion errors, than modals and auxiliary *be*. If the present study is to directly compare with this current finding, then the results from our finiteness test should correlate more strongly with the inversion of lexical and copular *be* verbs, those verbs which require V→I→C movement, then with the inversion of modal and auxiliary *be*, which only require I→C movement.

Warren (2007) suggests that there is a developmental connection between the grammatical structures of finiteness and subject-aux inversion. Similarly, Grinstead, Warren, Ricci, & Sanderson (2008) found that there was a significant correlation between the children's comprehension of tense marking and subject-verb inversion in *wh*-questions, which suggests that the Optional Infinitive Stage (Rice & Wexler 1996) can also be classified as the Optional Inversion Stage. Based on the data collected from 63 participants, this research also confirmed the V-to-I-to-C construct, due to the fact that finiteness marking was consistently as good as or better than inversion. Finally, Grinstead et al validate that only finite verbs may move from I-to-C which supports the argument that subject-auxiliary inversion is a syntactic marker of verb finiteness.

Specific Language Impaired Children

The causes and origins of specific language impairment are currently a much researched topic. In the past decade or so, there has been a lot of focus on the goal of isolating a grammatical clinical marker of SLI in children. Currently, detection of specific language impairment has been based on accepted exclusionary criteria of the disorder:

- Language ability – Language test scores of – 1.25 standard deviations or lower; at risk for social devalue
- Nonverbal IQ – Performance IQ of 85 or higher
- Hearing – Pass screening at conventional levels
- Otitis media with effusion – No recent episodes
- Neurological dysfunction – No evidence of seizure disorders, cerebral palsy, brain lesions; not under medication for control of seizures
- Oral structure – No structural anomalies
- Oral motor function – Pass screening using developmentally appropriate items
- Physical and social interactions – No symptoms of impaired reciprocal social interaction or restriction of activities

What years of research have shown is that there is a grammatical delay that appears in the linguistic development of SLI children. Though each child varies in degree of impairment, there are some common links that can be made between the majority of subjects. Two constructions which are problematic for children with SLI are finiteness marking and *wh*-questions.

Tense Deficits in SLI Children

As previously established, children between the ages of 3 and 5 years old operate with an Optional Infinitive grammar. In studies which focused on specific language impaired children, it was found that not only do they operate in this same OI stage, but they show an Extended Optional Infinitive (EOI) grammar (Rice & Wexler 1996a; Rice & Wexler 1996b; Rice, Wexler, & Hershberger 1998). Research shows that this EOI stage is characterized by a developmental delay in acquisition and production of finiteness marking. This stage appears to last well past the age of 6, when typically

developing children appear to have mastered adult grammatical constructs in their everyday production.

In a comparison between SLI children and their typically developing peers, with regard to target grammatical structure elicitations, SLI children proved to do drastically worse than typically developing children in the structures which related directly to finiteness (Håkansson 1998). The target structures, with the percent used by SLI children in obligatory contexts, included perfect tense (27%), verb-second (55%), and complementizers (4%) as compared with those results obtained by typically developing children (76%, 93%, 74%, respectively). Håkansson demonstrated that the overall knowledge and use of finiteness marking in SLI children is severely delayed (29%) compared with typically developing children (81%). Other research has successfully supported this idea of the EOI stage in SLI children, expanding and specifying the account to include other grammatical elements associated with finiteness including the complementizer 'that', infinitive marker 'to,' and arguments in finite complement clauses (Owen & Leonard 2006). Owen and Leonard concluded that the EOI stage lasts well past preschool and thus persists into much later stages of grammatical development.

Wh-Question Problems in SLI Children

There are many different theories which revolve around the idea of impaired question development in SLI children. There seems to be a common pattern of results which state that SLI children have more difficulty producing a syntactically accurate formation of *wh*-object questions as compared with *wh*-subject questions. The reason for this consistent error is due to the fact that in *wh*-subject questions, the word order remains

SVO, whereas in *wh*-object questions, subject-verb inversion must occur in the question. This inversion necessitates I→C movement, which proves difficult for SLI children.

Research has supported the idea that movement in general causes complications in the grammatical development of SLI children (van der Lely & Battell 2003). Other studies have shown that the problem that arises in the production and comprehension of *wh*-object questions is due to the fact that the distance between the *wh*-phrase and the object is much greater than in *wh*-subject questions (Hildebrand 1987; Deevy & Leonard 2004). Deevy explains that questions cannot be interpreted until the gap is identified, which takes much longer in *wh*-object questions.

Stavrakaki (2004) examines the issue even further by not only providing research that SLI children erroneously produced subject questions for object questions, but showing that that they have a tendency to convert non-referential questions into referential questions. For example, an SLI participant made the following conversion:

a. Who did the camel push? (non-referential)

b. Which camel pushed the rhino? (referential)

Summary

Typically developing children between the ages of 3 and 5 typically operate in an Optional Infinitive Stage and, according to mainstream generative syntactic accounts, in order to produce subject-aux inversion, the full movement of the verb must take place from V-to-I-to-C with no shortcuts. Research on specific language impairment has not only confirmed the Optional Infinitive Stage but has suggested that children with SLI operate in an Extended Optional Infinitive Stage, which lasts until around the age of 6. It

also has been shown that children with SLI have an impaired comprehension of tense marking as well as *wh*- question development as compared with their typically developing peers.

On the basis of these observations of developmental patterns that have been studied in typically developing children and specific language impaired children, we hope to make some conclusions of our own with respect to their knowledge and errors of finiteness marking and subject-verb inversion. We propose the following research questions:

1. Are finiteness and subject-aux inversion linked in development as suggested by preliminary results of Warren (2007)?
2. Given the finiteness deficit reported in children with specific language impairment, is there a proportionate deficit in finiteness in children with SLI?
3. Are children with SLI significantly worse at subject-aux inversion than the age-matched controls?
4. Seeking to validate Rice, Wexler, & Redmond's (1999) longitudinal study with a cross-sectionally designed study and with a grammaticality choice instead of a grammaticality choice task, are SLI children significantly worse than age matches at finiteness judgments?

Chapter 2: Experiment 1 – Finiteness Marking in Typically-Developing Children

Section 2.0: Introduction

Through the use of grammaticality choice tasks tested with 18 typically developing children, Warren (2007) showed that there is a connection between the comprehension of verb finiteness and subject-verb inversion. While clear and interesting results were obtained, they were preliminary. The sampling needed to be increased in order for convincing correlational tests to be done.

Section 2.1: Method

Participants

All participants selected for this task were monolingual native English speakers who were enrolled in resident daycares throughout Columbus, Ohio. After consent was given by the primary caretaker as well as from the child participant, all testing was administered on-site at the child's daycare facility. One hundred six children between the ages of 3;1 and 5;11 participated in this study. Out of the 106 participants, 54 children failed to pass the filler items of the Nonfinite Verb Grammaticality Choice Task (explained in detail later) and hence were eliminated from continuing the study. Their data were not considered in the final results. Of the 52 children who passed the finiteness task 7 failed the second task of subject-verb inversion thus making their finiteness data invalid. The mean age of the 45 children who passed both this task and the inversion task was 5;0. The 45 children tested for this thesis were added to the 18 tested in Warren

(2007) for a total of 63 children. The mean age of the total number of participants was 4;10.

Procedures

For the Nonfinite Verb Grammaticality Choice Task (Pratt and Grinstead 2007), children were introduced to two puppets (a lion and a penguin). The children were told that these were baby animals that were just learning to talk and that sometimes they mixed up their words. For this task, the child and the administrator looked at a picture and then each of the baby animals said a sentence about the picture. It was the child's responsibility to tell the administrator which animal said the sentence better. For each sentence given, the penguin always "spoke" first, as a way to provide consistency.

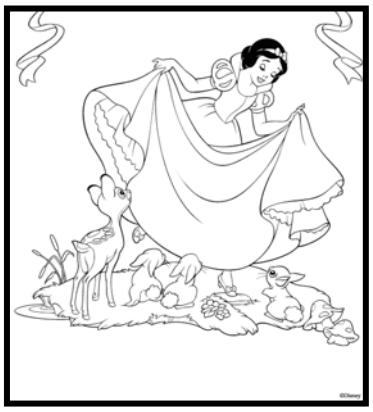

Figure 2 – Sample Picture Shown To Children

The following is an example of a test item in the Nonfinite Verb Grammaticality Choice Task:

Penguin puppet: Snow White sing to the animals.

Lion puppet: Snow White sing**s** to the animals.

Test Administrator: Who said it better, the penguin or the lion?

The finiteness test consisted of 4 practice statements used to introduce the test to the child, 24 statements graded for accuracy, and 4 filler statements, used to determine whether the child's data would be included in the pool. During the production of the practice statements, if the child answered incorrectly they were prompted to listen to the sentence again. If they answered correctly the second time, they were praised; however, if they answer incorrectly, the administrator told them the correct answer and explained to them why it was correct. It is important to note that after the second practice sentence, in which the second puppet got the answer correct, the administrator then explained to the child that "Sometimes the lion will get it right and sometimes the penguin will say it correctly, so we have to listen real closely to each sentence to figure out which puppet said the sentence better," in order to emphasize that no patterns of correct and incorrect productions were used. After the 4 practice statements, the child was rewarded with compliments on each statement, whether they answered correctly or not.

The actual questions consisted of pairs of sentences where one is correctly marked with finiteness and the other is incorrectly marked. It is important to note that each sentence, whether it was produced grammatically correct or incorrect, was a direct description of the picture presented to the child. Table 2.1 shows the breakdown of test components and examples of each of the verb tenses used in this task.

	Correct Response	Incorrect Response	Frequency in test
Copular *be*	Scooby **is** loud.	Scooby loud.	6
Auxiliary *be*	Mr. Cowboy **is** riding a horse.	Mr. Cowboy riding a horse.	6
Past tense *-ed*	The bear play**ed** in the sand	The bear play in the sand.	6
Present tense 3rd person singular *-s*	Snow White sing**s** to the animals.	Snow White sing to the animals.	6

Table 2.1 – Example Sentences from the Nonfinite Verb Grammaticality Choice Task

The purpose of the filler statements was to present the child with a morphological difference which they should have acquired and stored in their knowledge base by the age of 3 years old. The 4 filler questions consisted of the following compared sentences:

1. *The girl is swim.
   The girl is swimming.

2. The girl is picking flowers.
   *The girl is pick flowers.

3. Mickey is dancing.
   *Mickey is dance.

4. The bear is watching the butterfly.
   *The bear is watch the butterfly.

The administrator paid close attention to any sort of erroneous pattern developing in the child's pattern of answering the question and presented the filler statements in a way that would force the child to select the puppet opposite from the pattern they had developed. For example, if the child answered that the lion was right every time, on the filler question the administrator made the penguin say the correct statement. If the child missed more than one filler question, it was assumed that they did not understand the format of the task and their data was removed from the pool. In order for an individual's

test data to be documented and analyzed in this study, the child had to pass both of the tests administered.

Section 2.2: Results and Discussion

The overall results of the Nonfinite Verb Grammaticality Choice Task showed an average of 83% correctness across subjects. Participants' results showed the highest performance on copular *be* (91%) as compared with the lowest performance on auxiliary *be* (78%). Average scores for past tense *-ed* (81%) and present tense third person singular *-s* (86%) fell in the middle. Table 2.2 displays the average results of all participants whereas Table 2.3 breaks down the results according to the age of the participants.

	Average Score
Copular *be*	91% correct
Auxiliary *be*	78% correct
Past tense *–ed*	81% correct
Present tense 3rd person singular *-s*	86% correct

Table 2.2 – Overall Results on Finiteness Task

	Copular *be*	**Aux. *be***	***-ed***	***-s***	**Overall Average Score**
3 year olds n= 10	83% correct	63% correct	68% correct	58% correct	68% correct
4 year olds n= 23	92% correct	79% correct	83% correct	90% correct	86% correct
5 year olds n= 30	93% correct	82% correct	84% correct	93% correct	88% correct

Table 2.3 – Overall Results of Finiteness Task by age

As seen in Table 2.4, all of the finiteness variables correlated with one another, except auxiliary *be* and *–ed*.

Correlations

		Copular *be*	Aux *be*	*-ed*	*-s*
Copular *be*	Pearson Correlation	1	.311*	.415**	.594**
	Sig. (2-tailed)		.013	.001	.<.001
	N	63	63	63	63
Aux *be*	Pearson Correlation	.311*	1	.207	.477**
	Sig. (2-tailed)	.013		.104	.<.001
	N	63	63	63	63
-ed	Pearson Correlation	.415**	.207	1	.423**
	Sig. (2-tailed)	.001	.104		.001
	N	63	63	63	63
-s	Pearson Correlation	.594**	.477**	.423**	1
	Sig. (2-tailed)	<.001	.<.001	.001	
	N	63	63	63	63

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2.4 – Significant correlations among –s, -ed, auxiliary *be* and copular *be* on the finiteness grammaticality judgment test

Section 2.3: Summary and Conclusion

Three, 4, and 5 year old child English speakers showed a range of proficiency at distinguishing finite from nonfinite verbs. With the exception of auxiliary *be* and *–ed*, children's finiteness judgments were highly correlated.

Chapter 3: Experiment 2 – Subject-Auxiliary Inversion in Typically-Developing Children

Section 3.0: Introduction

In the previous experiment, we saw that children showed variation in their production of verb finiteness markers, which is consistent with some of them being in the Optional Infinitive stage. Now we turn to the question of whether children also show optional subject-auxiliary inversion in their grammars.

Section 3.1: Method

Participants

The participants for the Subject-Auxiliary Inversion Grammaticality Choice Task were selected based on successfully passing Experiment 1, the Nonfinite Verb Grammaticality Choice Task. These 52 children were between the ages of 3;1 and 5;11. Out of the 52 participants, 7 children failed to pass the Subject-Auxiliary Inversion Grammaticality Choice Task. Their data were not considered in the final results. Since the 45 children used for the final results of the finite test were the same as this inversion task, the mean age of 5;0 was the same. These children were added to the 18 from Warren (2007) for a total of 63 children, the mean age for whom was 4;10.

Procedures

The procedures for the Subject-Auxiliary Inversion Grammaticality Choice Task were the same as the Nonfinite Verb Grammaticality Choice Task; the only aspect that differed was the set of test questions as well as the coinciding pictures. The child was reminded about the structure of the test and what his role was in determining which puppet said the sentence better. The penguin, again, "spoke" first in order for there to be consistency within and between the two tests.

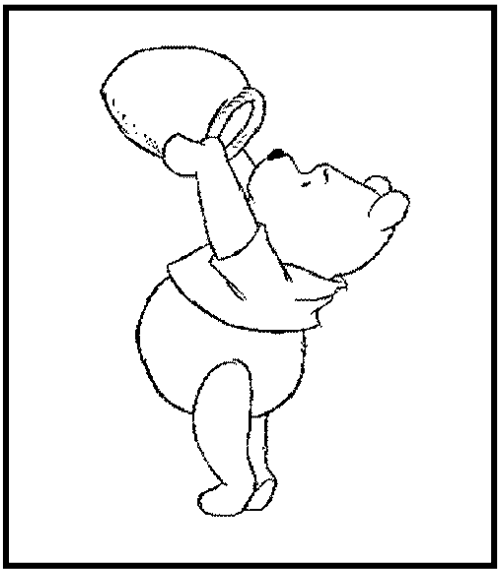

Figure 3 – Sample Picture Shown to Children

The following is an example of a test item in the Subject-Auxiliary Inversion Grammaticality Choice Task:

Penguin puppet: Why Pooh **is** looking in the pot?

Lion puppet: Why **is** Pooh looking in the pot?

Test Administrator: Who said it better, the penguin or the lion?

The inversion test format was similar to the finiteness test, as it consisted of 4 practice statements, 20 statements graded for accuracy, and 4 filler statements. The practice statements were, once again, used as a way to introduce the format of the test to the child and were not graded for accuracy. The administrator explained after the first two inversion practice questions that "Sometimes the lion will get it right and sometimes the penguin will say it correctly, so we have to listen real closely to each sentence to figure out which puppet said the sentence better." After the 4 practice statements were performed, the administrator interrupted the procedure and explained to the child the format of the rest of the test. In order to avoid confusion on the next portion, she explained that "Now, the puppets are going to ask you a question. You do not have to answer the question; you just have to tell me which puppet asked it better." It was then made clear that the child understood the rules before moving on to the actual portion of the test.

The inversion pairs each contained one question in which the subject and the verb were properly inverted and another in which no inversion occured. As in the other grammaticality task, each sentence, whether it was produced grammatically correct or incorrect, was a direct description of the picture presented to the child. It is important that the administrator asked both questions with the same degree of inflection, in order to avoid unintentionally leading the child to the correct answer. Table 3.1 shows the breakdown of test components and examples of each of the verb tenses used in this task. Each *wh*-question (what, where, when, why) was used 5 times throughout the task.

	Correct Response	Incorrect Response	Frequency in test
Copular *be*	When **is** the girl happy?	When the girl **is** happy?	4
Auxiliary *be*	Why **is** Pooh looking in the pot?	Why Pooh **is** looking in the pot?	4
Modal	Where **can** the baby turtle swim?	Where the baby turtle **can** swim?	4
Do support (past)	What **did** the monkey eat?	What the monkey **did** eat?	4
Do support (present)	Where **does** the crab live?	Where the crab **does** live?	4

Table 3.1 – Example Sentences from the Subject-Auxiliary Inversion Grammaticality Choice Task

The filler items were sentences which contained inversion of determiners and prepositions, but that appeared in a declarative form instead of a question. Each child should have had the grammatical comprehension to answer the filler items correctly. The purpose of the filler statements remained the same; to determine whether the child's data would be used in the study. The 4 filler questions consisted of the following compared sentences:

1. *The boy is building snowman a.
   The boy is building a snowman.

2. Aladdin can ride an elephant.
   *Aladdin can ride elephant an.

3. Mouse is in the pot.
   *Mouse is the pot in.

4. *Hippo splashed water the.
   Hippo splashed the water.

As in the finiteness test, the administrator modified which puppet said the correct/ incorrect statement in order to regain the child's focus, if needed.

Section 3.2: Results and Discussion

Based on the results of the Subject-Auxiliary Inversion Grammaticality Choice Task, the participants showed a greater strength for recognition of appropriate use of *do* support then any other verb type, with the use of the past tense form of the verb (85%) being slightly higher than the present tense form (84%). Across the board, the children appeared to struggle the most with the questions involving modals, achieving an average of just 72%. Copular and auxiliary *be* performance fell in the mid-range of scores with an average of 76% and 74%, respectively. Table 3.2 displays the average scores of all participants on the inversion task whereas Table 3.3 breaks down the results according to the age of the participants.

	Average Score
Copular *be*	76% correct
Auxiliary *be*	74% correct
Modal	72% correct
Do support (past)	85% correct
Do support (present)	84% correct

Table 3.2 – Overall Results on Inversion Task according to Verb Type

	Copular *be*	**Aux. *be***	**Modal**	**Do support (past)**	**Do support (present)**	**Overall Average Score**
3 year olds n= 10	58% correct	65% correct	73% correct	68% correct	65% correct	66% correct
4 year olds n= 24	72% correct	67% correct	65% correct	83% correct	84% correct	74% correct
5 year olds n= 29	85% correct	83% correct	78% correct	91% correct	90% correct	85% correct

Table 3.3 – Overall Results of Inversion Task by Age according to Verb Type

In Table 3.4, we see that judgments of all of the auxiliary verbs on the inversion test, with the exception of *do* and auxiliary *be* correlated with one another.

Correlations

		Did	Do	Copular	Aux	Modal
Did	Pearson Correlation	1	.589**	.462**	.317*	.364**
	Sig. (2-tailed)		<.001	<.001	.011	.003
	N	63	63	63	63	63
Do	Pearson Correlation	.589**	1	.431**	.230	.395**
	Sig. (2-tailed)	<.001		<.001	.070	.001
	N	63	63	63	63	63
Copular	Pearson Correlation	.462**	.431**	1	.498**	.459**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001
	N	63	63	63	63	63
Aux	Pearson Correlation	.317*	.230	.498**	1	.348**
	Sig. (2-tailed)	.011	.070	<.001		.005
	N	63	63	63	63	63
Modal	Pearson Correlation	.364**	.395**	.459**	.348**	1
	Sig. (2-tailed)	.003	.001	<.001	.005	
	N	63	63	63	63	63

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3.4 – Correlations of Auxiliary Verbs on the Subject-Auxiliary Inversion Test

Examining a different aspect of the Subject-Auxiliary Inversion Task, analysis of the use of *wh*-pronouns, performance was for the most part consistent across subjects. No matter the specific *wh*-pronoun used, average scores fell within a range between 71% (when) and 81% (what and where). Data results according to *wh*-question type are shown in Table 3.5 and in Table 3.6 according to age of the participant.

	Average Score
What	81% correct
When	71% correct
Where	81% correct
Why	78% correct

Table 3.5 – Overall results on Subject-Auxiliary Inversion Grammaticality Choice Task according to *wh*-question

	What	When	Where	Why	Overall Average Score
3 year olds n= 10	64% correct	68% correct	60% correct	70% correct	66% correct
4 year olds n= 24	82% correct	66% correct	78% correct	70% correct	74% correct
5 year olds n= 29	86% correct	77% correct	92% correct	87% correct	85% correct

Table 3.6 – Results of Subject-Auxiliary Inversion Grammaticality Choice Task by age according to *wh*-question

As illustrated in Table 3.6, judgments of inversion with *wh*- elements 'what' and 'why' correlated with the other *wh*- elements, while 'when' and 'where' correlated with everything but each other.

Correlations

		What	Where	When	Why
What	Pearson Correlation	1	.502**	.352**	.449**
	Sig. (2-tailed)		<.001	.005	<.001
	N	63	63	63	63
Where	Pearson Correlation	.502**	1	.225	.625**
	Sig. (2-tailed)	<.001		.076	<.001
	N	63	63	63	63
When	Pearson Correlation	.352**	.225	1	.364**
	Sig. (2-tailed)	.005	.076		.003
	N	63	63	63	63
Why	Pearson Correlation	.449**	.625**	.364**	1
	Sig. (2-tailed)	<.001	<.001	.003	
	N	63	63	63	63

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.7 – Correlations of Wh- Elements on the Subject-Auxiliary Inversion Test

Section 3.3: Summary and Conclusion

As with the finiteness test, children showed a range of proficiencies across the 3, 4 and 5 year old age range. Further, their inversion judgments were well-correlated both as a function of *wh*- word and auxiliary verb.

Chapter 4: Statistical Analysis of Finiteness and Inversion Tests

Section 4.1: Introduction

The two tests given to the children measured inversion and finiteness as independent variables. The finiteness test varied finiteness without varying word order and the inversion test varied word order without varying finiteness. If the theory proposed by mainstream generative grammar is correct we should expect to find that these results correlate. If such a correlation is found, we should then see whether particular elements within each test are more or less sensitive to elements on the other tests.

Section 4.2: Finiteness & Inversion

My first question is whether, as in Warren (2007), but now with a sample of 63 children, we still find a correlation of finiteness and inversion judgments. Table 4.1 illustrates that judgments of finiteness on the finiteness test and judgments of subject-auxiliary inversion on the inversion test are highly correlated.

Correlations

		Inversion	Finiteness
Inversion	Pearson Correlation	1	.525**
	Sig. (2-tailed)		<.001
	N	63	63
Finiteness	Pearson Correlation	.525**	1
	Sig. (2-tailed)	<.001	
	N	63	63

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.1 – Correlations of Inversion and Finiteness Judgments

The results in Table 4.1 confirm that inversion and finiteness are related across development and can be taken as a confirmation of the mainstream generative argument that finiteness is necessary for inversion. In syntactic terms, this correlation is consistent with the idea that V-to-I movement is necessary for I-to-C movement. As we saw in our earlier correlational tests, however, not all items correlated equally well, so I now turn to an examination of how individual verbal items predict one another, by linear regression.

Section 4.3: Finiteness and Inversion in Greater Detail

The finiteness test has 4 auxiliary types on it. Which of them is the best predictor of subject-auxiliary inversion?

Finiteness Component	Unstandardized Slope (B)	Standard Error	p Value
Copular *be*	.186	.162	.254
Auxiliary *be*	.083	.105	.432
-ed	-.014	.112	.901
-s	.342	.130	.011

Table 4.2 – *-s* finiteness judgments on test 1 predict overall inversion judgments on test 2, by linear regression

Table 4.2 shows that of the 4 elements on the finiteness test, *-s* is the only one that predicts overall inversion.

Now that we have established that –s is the variable on the finiteness test that is most sensitive to inversion, we ask which element on the inversion test is most sensitive to *–s*? None of the finiteness elements, including *–s*, predicted inversion of auxiliary *be*, copular

be or modal verb *can*. Nonetheless, *-s* does predict inversion of both present and past tense *do*-support, as illustrated in Tables 4.3 and 4.4.

Finiteness Component	Unstandardized Slope (B)	Standard Error	p Value
Copular *be*	.158	.194	.417
Auxiliary *be*	.103	.125	.414
-ed	.121	.134	.369
-s	.420	.155	.009

Table 4.3 – *-s* finiteness judgments on test 1 predict *do* judgments on test 2, by linear regression

Finiteness Component	Unstandardized Slope (B)	Standard Error	p Value
Copular *be*	.031	.208	.882
Auxiliary *be*	.065	.135	.631
-ed	-.023	.144	.874
-s	.486	.167	.005

Table 4.4 – *-s* finiteness judgments on test 1 predict *did* judgments on test 1, by linear regression

Section 4.4: Summary and Conclusion

Warren (2007) and Grinstead, Warren, Ricci & Sanderson (2009) claimed that the correlation between finiteness and inversion was a confirmation of the mainstream generative grammar hypothesis that finiteness is necessary for inversion. While our further analysis confirms this claim, in general, we have seen that in fact it is *–s* that predicts inversion and, furthermore, that what *–s* predicts is present and past tense *do* support.

Speculatively, it may be that the more morphologically regular nature of *-s* marking and *do* support, in contrast to auxiliary/copular *be* and modal *can*, is responsible for their correlation, as clear representatives of the syntax of finiteness and inversion, respectively.

Chapter 5: Future Directions: Finiteness Marking and Subject-Auxiliary Inversion in Children with Specific Language Impairment

Section 5.1: Work in Progress

Though this thesis was planned to encompass an SLI study, the process of identifying a sample was much slower than anticipated, so it will remain for future work. In what follows, I lay-out the design of the SLI version of this study and discuss its possible outcomes and significance.

Section 5.2: Finiteness and Subject-Auxiliary Inversion

Participants

The specific language impaired participants for this experiment will be obtained from the clientele of speech-language pathologists associated with Nationwide Children's Hospital. All participants will meet the criteria for specific language impairment based on both exclusionary and inclusionary criteria which include:

- Language ability – Language test scores of – 1.25 standard deviations or lower; at risk for social devalue
- Nonverbal IQ – Performance IQ of 85 or higher
- Hearing – Pass screening at conventional levels
- Otitis media with effusion – No recent episodes
- Neurological dysfunction – No evidence of seizure disorders, cerebral palsy, brain lesions; not under medication for control of seizures
- Oral structure – No structural anomalies
- Oral motor function – Pass screening using developmentally appropriate items
- Physical and social interactions – No symptoms of impaired reciprocal social interaction or restriction of activities

The typically developing children used for this experiment will be selected as an age-matched control group of the specific language impaired children. These participants also will pass the hearing screening, psychological examination, and will fall at or below 1.25 SD of the mean on the language assessments.

Procedures

Receptive and expressive language assessment tests, the Clinical Evaluation of Language Fundamentals Preschool (CELF P) and the Peabody Picture Vocabulary Test (PPVT), will be administered. Any subject who fails to achieve a score within 1.25 SD of the mean will be eliminated from the study immediately. The hearing screenings and psychological evaluations, used in order to determine individual components of the SLI criteria, will be administered by graduate students in audiology and psychology, respectively.

Once subjects successfully pass all language, hearing, and psychological screenings, they will participate in the Nonfinite Verb Grammaticality Choice Task (Pratt and Grinstead 2007). The procedure for administration of this task will remain identical to that in Experiment 1.

Tasks

The stimuli will be the same as those described for the previously reported experiments.

Section 5.3: Expected Outcomes

It has been established that children with specific language impairment operate in an Extended Optional Infinitive (EOI) stage until they are well passed the age of 6. Given this fact, we would assume that our tests would confirm Rice & Wexler's EOI stage and that the SLI population would perform more poorly on the finiteness test than the typically developing children. This would also confirm Håkansson's studies showing the same results, that SLI children demonstrated severely delayed comprehension of finiteness marking as compared with typically developing children. We would expect that SLI children would also fall behind their typically developing peers in comprehension of subject-aux inversion task due to problems comprehending movement in general as theorized by van der Lely & Battell. More specifically, the SLI children would have difficulty with I→C movement, hence subject–aux inversion, a hypothetically necessary step in the syntactic formation of questions.

I predict that even though the SLI children might perform worse on the two individual tasks as compared with the control group, there may still be a possibility that the finiteness and inversion scores would correlate. Given the research, there is no reason to believe that the same linguistic feature that drove the correlation between these two concepts in typically developing children would not present itself in children with SLI as well. It would be interesting though to see if the same pattern would present itself with *–s* being the predictive marker for *do* and *did* or if some other factor would come into play. We would assume that this *–s* would remain the predicative marker for *do* and *did* due to the morphological regularity of each of these features.

Section 5.4: Conclusion

Finiteness and subject-auxiliary inversion are two dimensions of grammar that appear to be related in typically developing children, as our results show. Further, if the V-to-I-to-C hypothetical construct is correct, our results show that the most regular finiteness marker in English, -s, appears to be the most reflective of V-to-I movement, while *did* and *do* appear to be the most reflective of I-to-C movement, as these were the components of the two constructions which seemed most tightly related. By expanding our research to encompass a specific language impaired population as well, we hope to find results that lead us to a better understanding of the disorder and how exactly it manifests itself in children. With such results, our goal is to narrow down the characteristics of SLI and be able to make an earlier diagnosis, which would lead to earlier and more concrete treatment of the disorder. The more we can learn about SLI through research and experimentation, the closer we will be to providing fuller, more well-rounded treatment of children who have this disorder.

Chapter 6: References

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Chapter 7: List of Tables

Experiment One – Finiteness Marking in Typically-Developing Children

Experiment Two – Subject-Auxiliary Inversion in Typically-Developing Children

Statistical Analysis of Finiteness and Inversion Tests

Chapter 8: Appendices

Appendix A – Stimuli Sentences

A.1 Nonfinite Verb Grammaticality Choice Task

Practice
1a. The girl is hugging the tiger.
1b. The girl is hug the tiger.
2a. The cat is watch the fish.
2b. The cat is watching the fish.
3a. Donald is taking a bath.
3b. Donald is take a bath.
4a. Cookie Monster is bake pies.
4b. Cookie Monster is baking pies.
Task
1a. Scooby is loud.
1b. Scooby loud.
2a. The mama elephant lift the baby elephant.
2b. The mama elephant lifted the baby elephant.
3a. Duck holding a cactus.
3b. Duck is holding a cactus.
4a. Oscar flies a kite.
4b. Oscar fly a kite.
5a. The girl is swim.
5b. The girl is swimming.
6a. The bear played in the sand.
6b. The bear play in the sand.
7a. Rabbit is watering the garden.
7b. Rabbit watering the garden.
8a. Piglet eat watermelon.
8b. Piglet eats watermelon.
9a. Daisy raked all the leaves.
9b. Daisy rake all the leaves.
10a. The girl is picking flowers.
10b. The girl is pick flowers.
11a. The dinosaur is big.
11b. The dinosaur big.

12a. The monkey eats ice cream.
12b. The monkey eat ice cream.
13a. Donald angry.
13b. Donald is angry.
14a. Goofy is playing soccer.
14b. Goofy playing soccer.
15a. Mickey is dancing.
15b. Mickey is dance.
16a. The boy jump in the water.
16b. The boy jumped in the water.
17a. Snow White sing to the animals.
17b. Snow White sings to the animals.
18a. Garfield is hungry.
18b. Garfield hungry.
19a. Kermit driving the racecar.
19b. Kermit is driving the racecar.
20a. The bear is watching the butterfly.
20b. The bear is watch the butterfly.
21a. The bear goes down the slide.
21b. The bear go down the slide.
22a. The bear play with the toy train.
22b. The bear played with the toy train.
23a. The sun is happy.
23b. The sun happy.
24a. The boy rides the bike.
24b. The boy ride the bike.
25a. Spongebob sad.
25b. Spongebob is sad.
26a. Pooh is eating honey.
26b. Pooh eating honey.
27a. The boy row the boat.
27b.The boy rowed the boat.
28a. Mr. Cowboy is riding a horse.
28b. Mr. Cowboy riding a horse.

A.2 Subject-Auxiliary Inversion Grammaticality Choice Task

Practice
1a. Elmo played with the puppy.
1b. Elmo played with puppy the.
2a. Garfield eats popcorn the.
2b. Garfield eats the popcorn.
3a. The kitty is the plane in.
3b. The kitty is in the plane.
4a. The girl holds the umbrella.
4b. The girl holds umbrella the.
Task
1a. What did the monkey eat?
1b. What the monkey did eat?
2a. Where the crab does live?
2b. Where does the crab live?
3a. Why the puppy is scared?
3b. Why is the puppy scared?
4a. When is Spongebob surfing?
4b. When Spongebob is surfing?
5a. The boy is building snowman a.
5b. The boy is building a snowman.
6a. What can Tigger do?
6b. What Tigger can do?
7a. When did Pooh have lunch?
7b. When Pooh did have lunch?
8a. Why the seal does balance the ball?
8b. Why does the seal balance the ball?
9a. Where is the turtle sledding?
9b. Where the turtle is sledding?

10a. Aladdin can ride an elephant.
10b. Aladdin can ride elephant an.
11a. Where Daisy is?
11b. Where is Daisy?
12a. Why the cat did climb the blocks?
12b. Why did the cat climb the blocks?
13a. When can the boy blow bubbles?
13b. When the boy can blow bubbles?
14a. What does the girl play?
14b. What the girl does play?
15a. Mouse is in the pot.
15b. Mouse is the pot in.
16a. Where the baby turtle can swim?
16b. Where can the baby turtle swim?
17a. When Garfield does hug the bear?
17b. When does Garfield hug the bear?
18a. What is the girl?
18b. What the girl is?
19a. Why Pooh is looking in the pot?
19b. Why is Pooh looking in the pot?
20a. Hippo splashed water the.
20b. Hippo splashed the water.
21a. When is the girl happy?
21b. When the girl is happy?
22a. Where the bear did jump?
22b. Where did the bear jump?
23a. What is the elephant reading?
23b. What the elephant is reading?
24a. Why will the boy sing?
24b. Why the boy will sing?

Appendix B – Stimuli Pictures

B.1 Nonfinite Verb Grammaticality Choice Task


















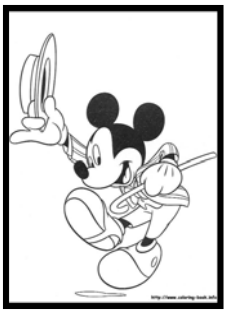






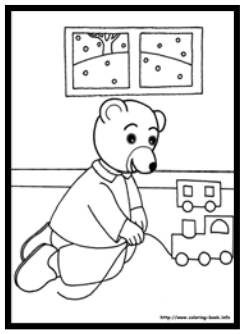
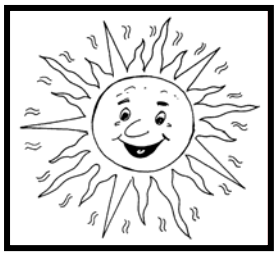




B.2 Subject-Auxiliary Inversion Grammaticality Choice Task